Claims

[c1] 1.An optical fiber bypass apparatus for use in an optical fiber hydrophone module for protecting optical bypass fiber, the module having a central axis and comprising the optical hydrophone assembly, an internal strength member, and a woven fiber protection cable assembly at each end of the module, the hydrophone assembly having two ends, being encircled in open-cell foam, and being aligned with the module central axis and comprising a plurality of mandrels helically wrapped with optical fiber and connected in linear relation, the internal strength member comprising at least one positioning tape and spanning the length of the module, the bypass apparatus comprising:

an elastic woven fiber bypass cable attached to the positioning tape at spaced intervals and at locations proximate to each end of the hydrophone assembly substantially parallel to the module central axis and alongside the hydrophone assembly; and

a jacketed optical fiber attached to one side of the bypass cable in a sinusoidal pattern, the jacket carrying the optical fiber as the fiber transitions from the woven fiber protection cable assembly at one end of the hydrophone assembly and carrying the optical fiber for the length of the hydrophone assembly until transitioning to the woven fiber protection cable on the other end of the hydrophone assembly,

wherein elongation of the bypass cable causes the period of the sinusoidal pattern to increase without imparting damaging stress to the optical fiber, and wherein the optical fiber transitions to the woven fiber protection cable at each end of the hydrophone module.

[c2] 2.A bypass apparatus as recited in claim 1, wherein the bypass cable and jacketed fiber are interposed between the open-cell foam and the positioning tape.

[c3] 3.A bypass apparatus as recited in claim 2, wherein the bypass elastic woven fiber cable is attached to the positioning tape at approximately 12-inch intervals.

[c4] 4.A bypass apparatus as recited in claim 1, wherein the elongation of the bypass cable is a minimum of 10 percent.

[c5] 5.A bypass apparatus as recited in claim 1, wherein the cable comprises elastane.

[c6] 6.A bypass apparatus as recited in claim 2, wherein the cable is woven from about 15 strands of elastane having a diameter of approximately 0.012 inches.

[c7] 7.A bypass apparatus as recited in claim 5, wherein the cable further comprises liquid crystal polymer thermoplastic multi-filament.

[c8] 8.A bypass apparatus as recited in claim 7, wherein two fibers of liquid crystal polymer thermoplastic multi-filament yarn are woven into the cable along the borders.

[c9] 9.A bypass apparatus as recited in claim 1, wherein the jacket is made of a thermoplastic polyester elastomer.

[c10] 10.A bypass apparatus as recited in claim 9, wherein the jacket further comprises a para-aramid fiber.

[c11] 11.A bypass apparatus as recited in claim 1, wherein the jacket comprises a tube.

[c12] 12.An optical fiber hydrophone module having a central axis and comprising:

an optical hydrophone assembly, having two ends, being encircled in open-cell foam, and being aligned with the module central axis, comprising a plurality of mandrels helically wrapped with optical fiber and connected in linear relation;

an internal strength member comprising at least one positioning tape and spanning the length of the module;

a woven fiber protection cable assembly at each end of the module;

an elastic woven fiber bypass cable attached to the positioning tape at spaced intervals and at locations proximate to each end of the hydrophone assembly, substantially parallel to the module central axis and alongside the hydrophone assembly; and

a jacketed optical fiber attached to one side of the bypass cable in a sinusoidal pattern, the jacket carrying the optical fiber as the fiber transitions from the woven fiber protection cable assembly at one end of the hydrophone assembly and carrying the optical fiber for the length of the hydrophone assembly until transitioning to the woven fiber protection cable on the other end of the hydrophone assembly,

wherein elongation of the bypass cable causes the period of the sinusoidal pattern to increase without imparting damaging stress to the optical fiber and wherein the optical fiber transitions to the woven fiber protection cable at each end of the hydrophone module.

[c13] 13.A bypass apparatus as recited in claim 12, wherein the bypass cable and jacketed fiber are interposed between the open-cell foam and the positioning tape.

[c14] 14.A method for protecting optical bypass fiber, the optical fiber bypass apparatus for use in an optical fiber hydrophone module, the module having a central axis and comprising the optical hydrophone assembly, an internal strength member, and a woven fiber protection cable assembly at each end of the module, the hydrophone assembly having two ends, being encircled in open-cell foam, and being aligned with the module central axis and comprising a plurality of mandrels helically wrapped with optical fiber and connected in linear relation, the internal strength member comprising at least one positioning tape and spanning the length of the module, comprising the steps of:
providing an elastic woven fiber bypass cable spanning the length of the module and substantially parallel to the module central axis and alongside the hydrophone assembly between each end of the hydrophone assembly;
attaching a jacketed fiber to one side of a bypass cable in a sinusoidal pattern, the jacketed fiber carrying the optical fiber as the fiber transitions from the woven fiber protection cable assembly at one end of the hydrophone assembly and carrying the optical fiber for the length of the hydrophone assembly until transitioning to the woven fiber protection cable on the other end of the hydrophone assembly; and
attaching the bypass cable at spaced intervals to the positioning tape and at locations proximate to each end of the hydrophone module;

wherein elongation of the cable causes the period of the sinusoidal pattern to increase without imparting damaging stress to the optical fiber.

[c15] 15.A bypass apparatus as recited in claim 14, wherein the bypass cable and jacketed fiber are interposed between the open-cell foam and the positioning tape.

[c16] 16.A method for protecting optical bypass fiber as recited in claim 14, further comprising the step of periodically attaching the bypass elastic woven fiber cable along the central portion of the cable to the positioning tape of the internal strength member.